

Curriculum Vitae

GEORGE BARANY

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Falcon Heights, Minnesota 55113-5545

Education:
The Rockefeller University, New York, Ph.D. 1977 (with R.B. Merrifield)
Major: Biochemistry
Minors: Organic and Physical Chemistry, Mathematics
Admitted to graduate program at The Rockefeller University in 1971
directly from Stuyvesant High School, New York

Professional Experience:

The Rockefeller University, Postdoctoral Fellow, 1977-1980
University of Minnesota, Assistant Professor of Chemistry, 1980-1986
Associate Professor of Chemistry, 1986-1991
Professor of Chemistry, 1991-present
Professor of Laboratory Medicine and Pathology, 1996-present
Member of graduate faculty, Department of Biochemistry, Molecular
Biology, and Biophysics, 1997-present
Distinguished McKnight University Professor, 1997-present

Honors and Awards:

The Rockefeller University Graduate Fellowships, 1972-1977
USPHS Postdoctoral Fellowship (with R.B. Merrifield), 1978-1980
Searle Scholars Program, 1982-1985
USPHS Research Career Development Award, 1982-1987
"America's 100 Brightest Scientists under 40," *Science Digest* survey,
December 1984
"Frontiers in Science" lecturer, Carlsberg Research Laboratories, Copenhagen,
Denmark, October 1991
Vincent du Vigneaud Award, outstanding achievements in peptide research, 1994
Distinguished McKnight University Professorship, University of Minnesota, 1997
Ralph F. Hirschmann Award in Peptide Chemistry, American Chemical
Society, 2006
Murray Goodman Scientific Excellence & Mentorship Award, American Peptide
Society, 2015

Publications:

170 Refereed Journal Papers, 120 Refereed Proceedings, 50 Reviews, 36 Patents
Issued or Allowed, about 100 Abstracts and Meeting Contributions

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Curriculum Vitae (continued)

Research Interests:

peptide synthesis, particularly the solid-phase method
protecting groups for organic functionalities, with an emphasis on the concept of
“orthogonality”
chemistry of thiols, disulfides, and polysulfanes
sulfurization reagents for synthetic antisense DNA and RNA
functionalization of soluble and insoluble polymers
elucidation of labile structures by mass spectrometry
pharmaceutical effects of garlic and onion constituents
rational design of protein analogues with altered specificities
mechanism of protein folding
role of sugars, phosphates, and other post-translational modifications for structure
and function of peptide conjugates
preparation of DNA and peptide nucleic analogue (PNA) arrays for detection of
genetic diseases [co-inventor of ‘zip-code’ addressing concept]
chemical combinatorial libraries

Extracurricular Interests:

tennis, opera, invention of board games, crossword puzzle construction

Professional Societies:

Sigma Xi, 1976
American Society for Mass Spectrometry, 1976
American Chemical Society, 1979
New York Academy of Sciences, 1980
American Association for the Advancement of Science, 1980
American Peptide Society, 1990
American Society for Biochemistry and Molecular Biology, 1993
The Protein Society, 1994

Selected Professional Activities:

American Peptide Society

Co-Creator, original American Peptide Society web site (with M. Songster) at
<http://www.chem.umn.edu/orgs/ampepsoc/apshome.html>, 1996
Program committee, Fifteenth American Peptide Symposium, 1997
Member, Publications committee, American Peptide Society, 1996-1999
Chair, Nominations committee, American Peptide Society, 1991-1993
Council, American Peptide Society, 1993-1999 (elected for 6-year term)
Co-Chair (with G.B. Fields), Sixteenth American Peptide Symposium,
Minneapolis, Minnesota, June 26 - July 1, 1999;
<http://www.chem.umn.edu/16aps/>
Organizing committee, Merrifield Symposium, San Diego, California, June 15,
2001, “Crossroads of Chemistry and Biology”
Member, Nominations committee, American Peptide Society, 2003-2005

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Curriculum Vitae (continued)

Selected Professional Activities (continued)

Editorial Boards, Organization Boards, and Grant Review Panels

Ad hoc member, Bio-organic and natural products chemistry study section,
National Institutes of Health, February 1988 and June 1991

Editorial Board, *Int. J. Peptide Protein Res.*, 1992-1996

Postdoctoral fellowship review panel, National Science Foundation,
Chemistry division, February 1993

Member, Multidisciplinary special emphasis study section to review SBIR
grant applications, National Institutes of Health, March 1993

Site visit team, Medical Research Council (Canada), March 1993

Editorial Board, *Letters in Peptide Science*, 1994-2004

Member, *ad hoc* review committee, National Institute on Aging, October, 1994

Editorial Board, *J. Peptide Res.*, 1997-2005

Minnesota Academy of Science, Board of Directors, 1999-2002

Editorial Advisory Board, *Solid-Phase Organic Syntheses*, 1998-present

Editorial Board, *Biopolymers (Peptide Science)*, 2004-present

Editorial Board, *Int. J. Pept. Res. Therapeutics*, 2005-present

Editorial Board, *Chemical Biology & Drug Design*, 2006-present

University of Minnesota (not including Department of Chemistry)

Steering committee, University of Minnesota Microchemical Facility
(Departments of Microbiology, Laboratory Medicine and Pathology, and
Institute of Human Genetics), 1985-1993

Steering committee, University of Minnesota Biomedical Engineering Center
Mass Spectrometry Research Facility, 1992-1997

Steering committee, NIH predoctoral training grant entitled "Chemical Basis of
Cellular and Molecular Biology," 1994-1996

Mentor, McNair Scholars program [to encourage and assist undergraduates who
are financially disadvantaged or members of underrepresented groups],
1995, 1996, 1997, 2002, 2013

University of Minnesota, Institute of Technology, Promotion and Tenure
Advisory committee, 1996-1999

Initial organizer, and later steering committee member, NIH "Chemistry-Biology
Interface" predoctoral training grant (CBITG), 1999-2001

University of Minnesota, Institute of Technology Consultative Committee,
2003-2005

Consulting (selected representative)

Consultant on new methods for peptide synthesis, PE Biosystems, Framingham,
Massachusetts (originally Biosearch in Novato, California), 1985-1999

Consultant on multiple syntheses and peptide drug discovery,
Arris Pharmaceutical Corporation, South San Francisco, 1992-1994

Consultant on peptide synthesis reagents and resins,
Peptides International, Inc., Louisville, Kentucky, 2000-present

Consultant on peptide-related legal matters, Sterne, Kessler, Goldstein & Fox,
Washington D.C., 2002-2003

Consultant on peptide synthesis, R & D Systems, Inc., Minneapolis, Minnesota,
2002-2003

Consultant on bio-orthogonality and silanol chemistry, Coferon, Inc., Stony Brook,
NY, 2009-2010

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Curriculum Vitae (continued)

A total of 376 publications is divided into the following categories (listed chronologically within each category; submitted ones are also listed but not numbered):

170 refereed papers in international scientific journals, published and in press
120 refereed proceedings of scientific conferences
50 invited review articles and book chapters
36 U.S. patents issued and allowed

In addition, an estimated > 100 abstracts and meeting contributions and > 100 invited lectures and seminars are no longer tabulated.

h index 42 (Web of Science) and 53 (Google Scholar) (both checked December 2014)

Refereed Journal Papers

1. George Barany and R.B. Merrifield. An ATP-Binding Peptide. *Cold Spring Harbor Symposium on Quant. Biol.* **37**, 121-125 (1973).
2. George Barany and R.B. Merrifield. A New Amino Protecting Group Removable by Reduction. Chemistry of the Dithiasuccinoyl (Dts) Function. *J. Am. Chem. Soc.* **99**, 7363-7365 (1977). Cited > 140 times since 1994.
3. S.B.H. Kent, A.R. Mitchell, G. Barany, and R.B. Merrifield. Test for Racemization in Model Peptide Synthesis by Direct Chromatographic Separation of Diastereomers of the Tetrapeptide Leucylalanylglycylvaline. *Anal. Chem.* **50**, 155-159 (1978).
4. George Barany, Bernard W. Fulpius, and T.P. King. Convenient New Procedures for the Synthesis of Ethoxythiocarbonyl Derivatives of Amino Acids. *J. Org. Chem.* **43**, 2930-2932 (1978).
5. George Barany and R.B. Merrifield. A Chromatographic Method for the Quantitative Analysis of the Deprotection of Dithiasuccinoyl (Dts) Amino Acids. *Anal. Biochem.* **95**, 160-170 (1979).
6. George Barany and R.B. Merrifield. Kinetics and Mechanism of the Thiolytic Removal of the Dithiasuccinoyl (Dts) Amino Protecting Group. *J. Am. Chem. Soc.* **102**, 3084-3095 (1980). With Supplementary Material: 9 pages.
7. George Barany. The Explicit Analysis of Consecutive Pseudo-First-Order Reactions: Application to Kinetics of Thiolysis of Dithiasuccinoyl (Dts) Amino Acids. *Anal. Biochem.* **109**, 114-122 (1980).
8. George Barany. Chemistry of carbamoyl disulfide protected derivatives of proline. *Int. J. Pept. Prot. Res.* **19**, 321-324 (1982).
9. George Barany. *N*^α-Dithiasuccinoyl (Dts)-L-Phenylalanine. C₁₁H₉NO₄S₂. *Cryst. Struct. Comm.* **11**, 913-928 (1982).

Bibliography of George Barany (continued)

Refereed Journal Papers (continued)

10. George Barany, Alayne L. Schroll, Andrew W. Mott, and David A. Halsrud. A General Strategy for Elaboration of the Dithiocarbonyl Functionality, $-(C=O)SS-$: Application to the Synthesis of Bis(chlorocarbonyl)disulfane and Related Derivatives of Thiocarbonic Acids. *J. Org. Chem.* **48**, 4750-4761 (1983). With Supplementary Material: 28 pages. Cited > 70 times.
11. George Barany. An Unusual Rearrangement, and Further Transformations, in the Chlorination of Alkoxythiocarbonylsulfenyl Substrates. *Tetrahedron Lett.* **24**, 5683-5686 (1983).
12. Urszula Słomczyńska and George Barany. Efficient Synthesis of 1,2,4-Dithiazolidine-3,5-diones (Dithiasuccinoyl-amines) and Observations on Formation of 1,2,4-Thiadiazolidine-3,5-diones by Related Chemistry. *J. Heterocyclic Chem.* **21**, 241-246 (1984).
13. Fernando Albericio and George Barany. Application of *N,N*-dimethylformamide dineopentyl acetal for efficient anchoring of N^{α} -9-fluorenylmethyloxycarbonylamino acids as *p*-alkoxybenzyl esters in solid-phase peptide synthesis. *Int. J. Pept. Prot. Res.* **23**, 342-349 (1984).
14. George Barany and Andrew W. Mott. Chemistry of Bis(alkoxycarbonyl)polysulfanes and Related Compounds. *J. Org. Chem.* **49**, 1043-1051 (1984). With Supplementary Material: 6 pages.
15. Andrew W. Mott, Steven J. Eastep, Urszula Słomczyńska, and George Barany. Preparation of [^{18}O]-Chlorocarbonylsulfenyl Chloride. *J. Labelled Compd. Radiopharmaceut.* **21**, 329-336 (1984).
16. Andrew W. Mott and George Barany. A New Method for the Synthesis of Unsymmetrical Trisulfanes. *Synthesis*, pp. 657-660 (1984).
17. Andrew W. Mott and George Barany. Synthesis and Characterisation of Bis[(methylthio)carbonyl]polysulphanes. *J. Chem. Soc., Perkin Trans. I*, pp. 2615-2621 (1984). With Supplementary Material: 12 pages.
18. Andrew W. Mott and George Barany. The Reaction of Methoxycarbonyl Disulfanes and Trisulfanes with Hydrogen Sulfide: A New Preparation of Some Symmetrical Alkyl Pentasulfanes. *Sulfur Letters* **2**, 137-142 (1984).
19. Steven Rudd and George Barany. 3-Methyl-2(3*H*)-benzothiazolone, C_8H_7NOS . *Acta Cryst. C* **40**, 2118-2120 (1984). With Supplementary Material: 6 pages.
20. Andrew W. Mott and George Barany. Chlorination of Methylthio(thiocarbonyl) Compounds with Sulfuryl Chloride. *Sulfur Letters* **2**, 241-248 (1984).
21. Fernando Albericio and George Barany. Improved approach for anchoring N^{α} -9-fluorenylmethyloxycarbonylamino acids as *p*-alkoxybenzyl esters in solid-phase peptide synthesis. *Int. J. Pept. Prot. Res.* **26**, 92-97 (1985). Cited > 70 times since 1994.

Bibliography of George Barany (continued)

Refereed Journal Papers (continued)

22. George Barany and Fernando Albericio. A Three-Dimensional Orthogonal Protection Scheme for Solid-Phase Peptide Synthesis under Mild Conditions. *J. Am. Chem. Soc.* **107**, 4936-4942 (1985). With Supplementary Material: 12 pages. Cited > 100 times since 1994.
23. Alayne L. Schroll and George Barany. Novel Symmetrical and Mixed Carbamoyl and Amino Polysulfanes by Reactions of (Alkoxydichloromethyl)polysulfanyl Substrates with *N*-Methylaniline. *J. Org. Chem.* **51**, 1866-1881 (1986). With Supplementary Material: 21 pages.
24. Velta L. Sparnins, Andrew W. Mott, George Barany, and Lee W. Wattenberg. Effects of Allyl Methyl Trisulfide on Glutathione *S*-Transferase Activity and BP-Induced Neoplasia in the Mouse. *Nutrition and Cancer: An International Journal* **8**, 211-215 (1986). Cited > 100 times since 1994.
25. Perry B. Hackett, Robert B. Petersen, Charles H. Hensel, Fernando Albericio, Samuel I. Gunderson, Ann C. Palmenberg, and George Barany. Synthesis *in Vitro* of a Seven Amino Acid Peptide Encoded in the Leader RNA of Rous Sarcoma Virus. *J. Mol. Biol.* **190**, 45-57 (1986). Cited > 50 times since 1994.
26. Daniel G. Mullen and George Barany. A New Fluoridolysable Anchoring Linkage for Orthogonal Solid-Phase Peptide Synthesis: Preparation and Properties of the *N*-(3 or 4)-[[[(4-Hydroxymethyl)phenoxy-*t*-butylphenyl]silyl]phenyl]pentanedioic Acid, Monoamide (Pbs) Handle. *Tetrahedron Lett.* **28**, 491-494 (1987).
27. Fernando Albericio and George Barany. Mild, orthogonal solid-phase peptide synthesis: use of *N*^α-dithiasuccinoyl (Dts) amino acids and *N*-(*iso*-propyldithio)carbonylproline, together with *p*-alkoxybenzyl ester anchoring linkages. *Int. J. Pept. Prot. Res.* **30**, 177-205 (1987).
28. Fernando Albericio and George Barany. An acid-labile anchoring linkage for solid-phase synthesis of *C*-terminal peptide amides under mild conditions. *Int. J. Pept. Prot. Res.* **30**, 206-216 (1987). Cited > 100 times since 1994.
29. Shmuel Zalipsky, Fernando Albericio, Urszula Słomczyńska, and George Barany. A convenient general method for synthesis of *N*^α- or *N*^ω-dithiasuccinoyl (Dts) amino acids and dipeptides: application of polyethylene glycol as a carrier for functional purification. *Int. J. Pept. Prot. Res.* **30**, 740-783 (1987).
30. Velta L. Sparnins, George Barany, and Lee W. Wattenberg. Effects of organosulfur compounds from garlic and onions on benzo[*a*]pyreneinduced neoplasia and glutathione *S*-transferase activity in the mouse. *Carcinogenesis* **9**, 131-134 (1988). Cited > 360 times since 1994.
31. Daniel G. Mullen and George Barany. A New Fluoridolyzable Anchoring Linkage for Orthogonal Solid-Phase Peptide Synthesis: Design, Preparation, and Application of the *N*-(3 or 4)-[[4-(Hydroxymethyl)phenoxy]-*tert*-butylphenylsilyl]phenyl Pentanedioic Acid, Monoamide (Pbs) Handle. *J. Org. Chem.* **53**, 5240-5248 (1988). With Supplementary Material: 5 pages.
32. Alayne L. Schroll and George Barany. A New Protecting Group for the Sulfhydryl Function of Cysteine. *J. Org. Chem.* **54**, 244-247 (1989).

Bibliography of George Barany (continued)

Refereed Journal Papers (continued)

33. Lee W. Wattenberg, Velta L. Sparnins, and George Barany. Inhibition of *N*-Nitrosodiethylamine Carcinogenesis in Mice by Naturally Occurring Organosulfur Compounds and Monoterpenes. *Cancer Research* **49**, 2689-2692 (1989). Cited > 230 times since 1994.
34. Carlos García-Echeverría, Fernando Albericio, Miquel Pons, George Barany, and Ernest Giralt. Convenient Synthesis of a Cyclic Peptide Disulfide: A Type II β -Turn Structural Model. *Tetrahedron Lett.* **30**, 2441-2444 (1989).
35. Sidney Belman, Jerome Solomon, Alvin Segal, Eric Block, and George Barany. Inhibition of Soybean Lipoxygenase and Mouse Skin Tumor Promotion by Onion and Garlic Components. *J. Biochem. Toxicology* **4**, 151-160 (1989).
36. Alayne L. Schroll, Steven J. Eastep, and George Barany. Synthesis and Characterization of (Methoxy(thiocarbonyl)sulfonyl Chloride. *J. Org. Chem.* **55**, 1475-1479 (1990). With Supplementary Material: 7 pages.
37. Fernando Albericio, Robert Van Abel, and George Barany. Solid-phase synthesis of peptides with *C*-terminal asparagine or glutamine. An effective, mild procedure based on *N*^α-fluorenylmethyloxycarbonyl (Fmoc) protection and side-chain anchoring to a tris(alkoxy)benzylamide (PAL) handle. *Int. J. Pept. Prot. Res.* **35**, 284-286 (1990).
38. Eduard Bardají, Josep L. Torres, Pere Clapés, Fernando Albericio, George Barany, and Gregorio Valencia. Solid-Phase Synthesis of Glycopeptide Amides under Mild Conditions: Morphiceptin Analogues. *Angew. Chemie Int. Ed. Engl.* **29**, 2912-2919 (1990). Also published in German: Festphasen-Synthese von Glycopeptidamiden unter milden Bedingungen: Morphiceptin-Analoga. *Angew. Chem.* **102**, 311-313 (1990).
39. Fernando Albericio, Nancy Kneib-Cordonier, Sara Biancalana, Lajos Gera, R. Irene Masada, Derek Hudson, and George Barany. Preparation and Application of the 5-(4-(9-Fluorenylmethyloxycarbonyl)aminomethyl-3,5-dimethoxyphenoxy)valeric Acid (PAL) Handle for the Solid-Phase Synthesis of *C*-Terminal Peptide Amides under Mild Conditions. *J. Org. Chem.* **55**, 3730-3743 (1990). With Supplementary Material: 19 pages. Cited > 270 times since 1994.
40. Nancy Kneib-Cordonier, Fernando Albericio, and George Barany. Orthogonal solid-phase synthesis of human gastrin-I under mild conditions. *Int. J. Pept. Prot. Res.* **35**, 527-538 (1990).
41. Robert P. Hammer, Fernando Albericio, Lajos Gera, and George Barany. Practical approach to solidphase synthesis of *C*terminal peptide amides under mild conditions based on a photolysable anchoring linkage. *Int. J. Pept. Prot. Res.* **36**, 31-45 (1990).
42. Samuel Zalipsky and George Barany. Facile Synthesis of α -Hydroxy- ω -carboxymethyl-polyethylene oxide. *J. Bioactive Compatible Polymers* **5**, 227-231 (1990).
43. Mark T. Devlin, George Barany, and Ira W. Levin. Conformational Properties of Asymmetrically Substituted Mono-, Di- and Trisulfides: Solid and Liquid Phase Raman Spectra. *J. Mol. Structure* **238**, 119-137 (1990).

Bibliography of George Barany (continued)

Refereed Journal Papers (continued)

44. Fernando Albericio, Robert P. Hammer, Carlos García-Echeverría, M. Antònia Molins, Jane L. Chang, Mark C. Munson, Miquel Pons, Ernest Giralt, and George Barany. Cyclization of disulfide-containing peptides in solid-phase synthesis. *Int. J. Pept. Prot. Res.* **37**, 402-413 (1991). Cited > 85 times since 1994.
45. Fernando Albericio and George Barany. Hypersensitive Acid-Labile (HAL) Tris(alkoxy)benzyl Ester Anchoring for Solid-Phase Synthesis of Protected Peptide Segments. *Tetrahedron Lett.* **32**, 1015-1018 (1991).
46. Eduard Bardají, Joseph L. Torres, Pere Clapés, Fernando Albericio, George Barany, Raquel E. Rodriguez, María P. Sacristán, and Gregorio Valencia. Synthesis and Biological Activity of *O*-Glycosylated Morphiceptin Analogues. *J. Chem. Soc., Perkin Trans. 1*, pp. 1755-1759 (1991).
47. Mark C. Munson, Carlos García-Echeverría, Fernando Albericio, and George Barany. *S*-2,4,6-Trimethoxybenzyl (Tmob): A Novel Cysteine Protecting Group for the *N*^α-9-Fluorenylmethyloxycarbonyl (Fmoc) Strategy of Peptide Synthesis. *J. Org. Chem.* **57**, 3013-3018 (1992).
48. Núria A. Solé and George Barany. Optimization of Solid-Phase Synthesis of [Ala⁸]-dynorphin A. *J. Org. Chem.* **57**, 5399-5403 (1992). Cited > 180 times since 1994.
49. Marc Ferrer, Clare Woodward, and George Barany. Solid-phase synthesis of bovine pancreatic trypsin inhibitor (BPTI) and two analogues. A chemical approach for evaluating the role of disulfide bridges in protein folding and stability. *Int. J. Pept. Prot. Res.* **40**, 194-207 (1992).
50. Fernando Albericio and George Barany. Acidolytic cleavage of tris(alkoxy)benzylamide (PAL) "internal reference" amino acyl (IRAA) anchoring linkages: validation of accepted procedures in solid-phase peptide synthesis (SPPS). *Int. J. Pept. Prot. Res.* **41**, 307-312 (1993).
51. Steven A. Kates, Nuria A. Solé, Charles R. Johnson, Derek Hudson, George Barany, and Fernando Albericio. A Novel, Convenient, Three-Dimensional Orthogonal Strategy for Solid-Phase Synthesis of Cyclic Peptides. *Tetrahedron Lett.* **34**, 1549-1552 (1993). Cited > 180 times since 1994.
52. Elizabeth A. Ottinger, Laurie L. Shekels, David A. Bernlohr, and George Barany. Synthesis of Phosphotyrosine-Containing Peptides and Their Use as Substrates for Protein Tyrosine Phosphatases. *Biochemistry* **32**, 4354-4361 (1993). Cited > 75 times.
53. Mark C. Munson, Michal Lebl, Jiřina Slaninová, and George Barany. Solid-Phase Synthesis and Biological Activity of the Parallel Dimer of Deamino-Oxytocin. *Pept. Res.* **6**, 155-159 (1993).
54. Sushil K. Sharma, Michael F. Songster, Tracey L. Colpitts, Peter Hegyes, George Barany, and Francis J. Castellino. Reductive Amination with Tritylamine as an Ammonia Equivalent: Efficient Preparation of the 5-[4-[(9-Fluorenylmethyloxycarbonyl)amino]methyl]-3,5-dimethoxyphenoxy]valeric Acid (PAL) Handle for Peptide Synthesis. *J. Org. Chem.* **58**, 4993-4996 (1993). With Supplementary Material: 10 pages.

Bibliography of George Barany (continued)

Refereed Journal Papers (continued)

55. Mark C. Munson and George Barany. Synthesis of α -Conotoxin SI, a Bicyclic Tridecapeptide Amide with Two Disulfide Bridges: Illustration of Novel Protection Schemes and Oxidation Strategies. *J. Am. Chem. Soc.* **115**, 10203-10210 (1993). Cited > 50 times since 1994.
56. Samuel Zalipsky, Jane L. Chang, Fernando Albericio, and George Barany. Preparation and applications of polyethylene glycol-polystyrene graft resin supports for solid-phase peptide synthesis. *Reactive Polymers* **22**, 243-258 (1994). Cited > 115 times.
57. Marc Ferrer, George Barany, and Clare Woodward. Partially folded, molten globule and molten coil states of bovine pancreatic trypsin inhibitor. *Nature Structural Biology* **2**, 211-217 (1995). Cited > 60 times.
58. Robert J. Van Abel, Yi-Quan Tang, V.S.V. Rao, Craig H. Dobbs, Dat Tran, George Barany, and Michael E. Selsted. Synthesis and characterization of indolicidin, a tryptophan-rich antimicrobial peptide from bovine neutrophils. *Int. J. Pept. Prot. Res.* **45**, 401-409 (1995).
59. Elisar Barbar, George Barany, and Clare Woodward. Dynamic Structure of a Highly Ordered β -Sheet Molten Globule: Multiple Conformations with a Stable Core. *Biochemistry* **34**, 11423-11434 (1995). With Supporting Information: 3 pages.
60. Hong Pan, Elisar Barbar, George Barany, and Clare Woodward. Extensive Nonrandom Structure in Reduced and Unfolded Bovine Pancreatic Trypsin Inhibitor. *Biochemistry* **34**, 13974-13981 (1995). With Supporting Information: 4 pages. Cited > 50 times.
61. Elizabeth A. Ottinger, To Yuen Hui, Zhijun Man, George Barany, and David A. Bernlohr. *In vitro* association of the phosphatidylinositol-3-kinase regulatory subunit (p85) with the human insulin receptor. *Int. J. Pept. Prot. Res.* **46**, 346-353 (1995).
62. David Cowburn, Jie Zheng, Qinghong Xu, and George Barany. Enhanced Affinities and Specificities of Consolidated Ligands for the Src Homology (SH)₃ and SH₂ Domains of Abelson Protein-tyrosine Kinase. *J. Biol. Chem.* **270**, 26738-26741 (1995).
63. Michael F. Songster, Josef Vágner, and George Barany. Acid-labile handles for Fmoc solid-phase synthesis of peptide *N*-alkylamides. *Lett. Pept. Sci.* **2**, 265-270 (1996).
64. Elisar Barbar, George Barany, and Clare Woodward. Unfolded BPTI variants with a single disulfide bond have diminished non-native structure distant from the crosslink. *Folding & Design* **1**, 65-76 (1996) [invited research article for inaugural issue]. With Supporting Information: 8 pages.
65. Qinghong Xu, Jie Zheng, David Cowburn, and George Barany. Synthesis and characterization of branched phosphopeptides: Prototype consolidated ligands for SH(32) domains. *Lett. Pept. Sci.* **3**, 31-36 (1996).
66. Knud J. Jensen, Paul R. Hansen, D. Venugopal, and George Barany. Synthesis of 2-Acetamido-2-deoxy- β -D-glucopyranose *O*-Glycopeptides from *N*-Dithiasuccinoyl-Protected Derivatives. *J. Am. Chem. Soc.* **118**, 3148-3155 (1996). With Supporting Information: 3 pages. Cited > 50 times.

Bibliography of George Barany (continued)

Refereed Journal Papers (continued)

67. Qinghong Xu, Karin Musier-Forsyth, Robert P. Hammer, and George Barany. Use of 1,2,4-dithiazolidine-3,5-dione (DtsNH) and 3-ethoxy-1,2,4-dithiazoline-5-one (EDITH) for synthesis of phosphorothioate-containing oligodeoxyribonucleotides. *Nucleic Acids Res.* **24**, 1602-1607 (1996). Cited > 50 times.
68. Maria Kempe and George Barany. CLEAR: A Novel Family of Highly Cross-Linked Polymeric Supports for Solid-Phase Peptide Synthesis. *J. Am. Chem. Soc.* **118**, 7083-7093 (1996). With Supporting Information: 21 pages. Cited > 130 times.
69. Josef Vágner, George Barany, Kit. S. Lam, Viktor Krchňák, Nikolai F. Sepetov, James A. Ostrem, Peter Štrop, and Michal Lebl. Enzyme-mediated spatial segregation on individual polymeric support beads: Application to generation and screening of encoded combinatorial libraries. *Proc. Natl. Acad. Sci. USA* **93**, 8194-8199 (1996). Cited > 70 times.
70. Steven A. Kates, Núria A. Solé, Michael Beyermann, George Barany, and Fernando Albericio. Optimized Preparation of Deca(L-Alanyl)-L-Valinamide by 9-Fluorenylmethoxycarbonyl (Fmoc) Solid-Phase Synthesis on Polyethylene Glycol-Polystyrene (PEG-PS) Graft Supports, with 1,8-Diazobicyclo[5.4.0]-undec-7-ene (DBU) Deprotection. *Pept. Res.* **9**, 106-113 (1996). Cited > 50 times.
71. Lin Chen, Helena Bauerová, Jiřina Slaninová, and George Barany. Syntheses and Biological Activities of Parallel and Antiparallel Homo and Hetero Bis-Cystine Dimers of Oxytocin and Deamino-Oxytocin. *Pept. Res.* **9**, 114-121 (1996).
72. Yongxin Han, Susan L. Bontems, Peter Hegyes, Mark C. Munson, Charles A. Minor, Steven A. Kates, Fernando Albericio, and George Barany. Preparation and Applications of Xanthenylamide (XAL) Handles for Solid-Phase Synthesis of C-Terminal Peptide Amides under Particularly Mild Conditions. *J. Org. Chem.* **61**, 6326-6339 (1996).
73. Qinghong Xu, George Barany, Robert P. Hammer, and Karin Musier-Forsyth. Efficient introduction of phosphorothioates into RNA oligonucleotides by 3-ethoxy-1,2,4-dithiazoline-5-one (EDITH). *Nucleic Acids Res.* **24**, 3643-3644 (1996).
74. Lin Chen, Tracy R. Thompson, Robert P. Hammer, and George Barany. Synthetic, Mechanistic, and Structural Studies Related to 1,2,4-Dithiazolidine-3,5-dione. *J. Org. Chem.* **61**, 6639-6645 (1996).
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32. Jordi Alsina, Knud J. Jensen, Michael F. Songster, Josef Vágner, Fernando Albericio, and George Barany; checked by John Flygare and Monica Fernandez. Backbone Amide Linker (BAL) Strategy for Solid-Phase Synthesis. *In* "Solid-Phase Organic Syntheses" (Anthony W. Czarnik, ed.), Volume 1, Chapter 12, John Wiley & Sons, New York, 2001, pp. 121-138.
33. Gregg B. Fields, Janelle L. Lauer-Fields, Rong-qiang Liu, and George Barany. Principles and Practice of Solid-Phase Peptide Synthesis. *In* "Synthetic Peptides: A User's Guide" (G.A. Grant, ed.), 2nd Edition, W.H. Freeman & Co., New York, invited review article (update of 1992 chapter), 2001, pp. 93-219.
34. Lin Chen, Ioana Annis, and George Barany. Disulfide Bond Formation in Peptides. *In* "Current Protocols in Protein Science" (J.E. Coligan, B.M. Dunn, H.L. Ploegh, D.W. Speicher, and P.T. Wingfield, eds.), John Wiley & Sons, New York, 2001, pp. 18.6.1-18.6.19.
35. George Barany and Arthur M. Felix. Editorial: Bruce Merrifield at the "Crossroads of Chemistry and Biology." *Biopolymers (Pept. Sci.)* **60**, 169-170 (2001).
36. Luis Moroder, Hans-Jürgen Musiol, Norbert Schaschke, Lin Chen, Balazs Hargittai, and George Barany. Protection of the Thiol Group. *In* "Synthesis of Peptides and Peptidomimetics (Houben-Weyl E22a: Methods of Organic Chemistry)" (M. Goodman, A.M. Felix, L. Moroder, and C. Toniolo, eds.), Georg Thieme Verlag, Stuttgart and New York, 2002, pp. 384-424.
37. Simon K. Shannon and George Barany. 3-(4-Hydroxymethylphenoxy)propionic acid (PAB Linker). *In* "Encyclopedia of Reagents in Organic Synthesis" [Online] (L. Paquette, J. Rigby, W. Roush, and P. Wipf, eds.), John Wiley & Sons Ltd, Baffins Lane, U.K., 2003, www.mrw.interscience.wiley.com/eros/.
38. Clare Woodward, Natàlia Carulla, and George Barany. Native State Hydrogen-Exchange Analysis of Protein Folding and Protein Motional Domains. *Meth. Enzymol.* **380**, 379-400 (2004).

Bibliography of George Barany (continued)

Invited Review Articles and Book Chapters (continued)

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40. Mian Liu, David Live, and George Barany. Solid-Phase Synthesis of Mucin Glycopeptides. *Chimica Oggi/Chemistry Today* **22**, 30-34 (2004).
41. George Barany, Nancy Kneib-Cordonier, and Daniel G. Mullen. Polypeptide Synthesis, Solid-Phase Method. *In* "Encyclopedia of Polymer Science and Technology" (J.I. Kroschwitz, ed.), 3rd Edition, Volume 11, John Wiley & Sons, New York, invited review article, 2004, pp. 164-199.
42. Jordi Alsina, Steven A. Kates, George Barany, and Fernando Albericio. Backbone Amide Linker (BAL) Strategies for the Solid-Phase Synthesis of C-Terminal Modified Peptides. *In* "Methods in Molecular Biology: Peptide Synthesis and Applications" (John Howl, ed.), Volume 298, Chapter 12, Humana Press, Totowa, NJ, 2005, pp. 195-208.
43. George Barany, Robert S. Hodges, and Tomi K. Sawyer. Hail to the Editor-in-Chief: An Appreciation of Victor J. Hruby, Outstanding Scientist-Mentor-Leader in Peptide Research. *J. Pept. Res.* **65**, 516-517 (2005).
44. T.K. Sawyer, G. Barany, and R.S. Hodges. Peptide chemical biology and drug design: a tribute issue to Editor-in-Chief Victor J. Hruby. *J. Pept. Res.* **66**, 221 (2005).
45. T.K. Sawyer, G. Barany, and R.S. Hodges. Hail to the Editor-in-Chief: Congratulatory wishes and special commentaries to Victor J. Hruby from both past and present students, postdoctoral fellows, visiting scientists, collaborators, colleagues and friends in peptide research. *J. Pept. Res.* **66**, 312-318 (2005).
46. Svetlana Mojsov and George Barany. Editorial: A Tribute to Bruce Merrifield. *Biopolymers (Pept. Sci.)* **90**, 154 (2008). Special Issue Dedicated to the Memory of Bruce Merrifield (325 pages).
47. Adam W. Barb, Andrew J. Borgert, Mian Liu, George Barany, and David Live. Intramolecular Glycan-Protein Interactions in Glycoproteins. *Meth. Enzymol.* **478**, 365-388 (2010).
48. Judit Tulla-Puche, Rita S. Majerle, Fernando Albericio, and George Barany. Resin-to-resin Transfer Reactions (RRTR) via Sonogashira Coupling. *In* "Solid-Phase Organic Syntheses" (P.J.H. Scott, ed.), Volume 2 (Solid-Phase Palladium Chemistry), Chapter 6, John Wiley & Sons, Hoboken NJ, 2012, pp. 59-66.
49. Fernando Porcelli, Ayyalusamy Ramamoorthy, George Barany, and Gianluigi Veglia. On the role of NMR spectroscopy for the characterization of antimicrobial peptides. *In* "Methods in Molecular Biology" (Alessandro Senes and Giovanna Ghirlanda, eds.; John and Jan Walker, series eds.), Springer Science - Humana Press, 2013, pp. 159-180.
50. George Barany. Orthogonal Solid-Phase Peptide Synthesis. *In* "Peptides 2015: Proceedings of the Twenty-Fourth American Peptide Symposium" (V. Srivastava, A. Yudin, M. Lebl, eds.), Prompt Scientific Publishing, San Diego, U.S.A., 2015, pp.1-8.

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Patents

1. George Barany. Xanthenylamide handle for use in peptide synthesis. U.S. patent 5,117,009, filed August 31, 1990 and issued on May 26, 1992. See also *Chem. Abstr.* **117**, 8494u (1992), entitled "Preparation of xanthenylamide handle for use in peptide synthesis and support incorporating it." Licensed to MilliGen/Biosearch for several years.
2. George Barany and Fernando Albericio. Hypersensitive acid-labile handle for solid-phase peptide synthesis. U.S. patent 5,196,566, filed August 31, 1990 and issued on March 23, 1993. See also *Chem. Abstr.* **119**, 139796h (1993). Licensed to MilliGen/Biosearch for several years.
3. George Barany, Fernando Albericio, Jane Chang, Samuel Zalipsky, and Nuria A. Solé (amended list of inventors; Solé not part of original filing). Polyethylene glycol derivatives for solid-phase applications. U.S. patent 5,235,028, filed August 31, 1990, amended June 14, 1991 and September 16, 1991, and issued on August 10, 1993. See also *Chem. Abstr.* **117**, 172114r (1992). Licensed to MilliGen/Biosearch and its successors. As of January 2004, this patent and its "relatives" had generated over a quarter of a million dollars in royalties, and as such, ranked in the top 30 or so technologies developed in the history of the University of Minnesota.
4. George Barany. Xanthenylamide Handle for Use in Peptide Synthesis. U.S. patent 5,306,562, filed May 15, 1992 and issued on April 26, 1994. See also *Chem. Abstr.* **122**, 82079g (1995). Licensed to MilliGen/Biosearch for several years.
5. George Barany, Jane Chang, Nuria A. Solé, Fernando Albericio, and Samuel Zalipsky. Resin for solid-phase peptide synthesis and methods of making it. European Patent 95112933.7-2109, filed August 27, 1991, and issued on October 24, 1995. Please see description of U.S. patent.
6. George Barany, Fernando Albericio, Jane Chang, Samuel Zalipsky, and Nuria A. Solé. Polyethylene glycol derivatives for solid-phase applications. European Patent 91916082.0-2109 0546055, filed August 27, 1991, and issued on July 10, 1996. Please see description of U.S. patent.
7. George Barany, Fernando Albericio, Nuria A. Solé, Jane Chang, and Samuel Zalipsky. Polyethylene glycol derivatives for solid-phase applications. U.S. patent 5,545,698 filed November 10, 1993, and issued August 13, 1996. See also *Chem. Abstr.* **125**, 223972 (1996). Licensed to MilliGen/Biosearch and its successors; see earlier description for the financial impact of this invention.
8. Maria Kempe and George Barany. Highly cross-linked polymeric supports. U.S. patent 5,656,707, filed June 16, 1995, and issued August 12, 1997. See also *Chem. Abstr.* **126**, 158526 (1997) and **131**, 19959 (1999). Licensed to Peptides International, Louisville, KY.

Bibliography of George Barany (continued)

Patents (continued)

9. George Barany, Robert P. Hammer, Karin Musier-Forsyth, Qinghong Xu, and Lin Chen. Sulfurization of phosphorus-containing compounds. U.S. patent 5,852,168, filed April 30, 1996, and issued December 22, 1998. See also *Chem. Abstr.* **127**, 359055 (1997), entitled "Sulfuration of DNA and RNA using disulfide-containing five-membered heterocycles." Licensed to PerSeptive Biosystems, Framingham, MA, and later to Applied Biosystems/Perkin Elmer Inc., Foster City, CA; non-exclusive license from January to July 2004 to Transgenomic, Inc., Omaha, NE.
10. Maria Kempe and George Barany. Highly cross-linked polymeric supports. U.S. patent 5,910,554, filed June 14, 1996, and issued June 8, 1999. See also *Chem. Abstr.* **126**, 158526 (1997) and **131**, 19959 (1999). Licensed to Peptides International, Louisville, KY.
11. George Barany, Fernando Albericio, Knud J. Jensen, Michael F. Songster, Jordi Alsina [listed as Jorge Alsina-Fernandez], and Josef Vágner. Support material for solid phase Organic Synthesis. U.S. patent 5,917,015, filed June 18, 1996, and issued June 29, 1999. See also *Chem. Abstr.* **131**, 73977 (1999). Licensed to PerSeptive Biosystems, Framingham, MA, and later to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.
12. David Cowburn, Jie Zheng, George Barany, and Qinghong Xu. Consolidated ligands with increased affinities and methods of use thereof. U.S. Provisional Application Serial No. 08/543,184, Attorney Docket Number 600-1-145, University of Minnesota Docket Number 95171, filed October 13, 1995. See also *Chem. Abstr.* **128**, 305398 (1999) entitled "Fusion proteins containing multiple domains binding to a target protein and their investigative and therapeutic uses."
13. Francis Barany, Matthew Lubin, Robert P. Hammer, and George Barany. Detection of nucleic acid sequence differences using coupled ligase detection and polymerase chain reactions. U.S. patent 6,027,889, filed May 28, 1997 and issued February 22, 2000. Licensed to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.
14. Francis Barany, Matthew Lubin, Phillip Belgrader, Robert P. Hammer, and George Barany. Detection of nucleic acid sequence differences using coupled ligase detection and polymerase chain reactions. U.S. patent 6,268,148 filed November 15, 1999 and issued July 31, 2001. Licensed to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.
15. Francis Barany, George Barany, Robert P. Hammer, Maria Kempe, Herman Blok, and Monib Zirvi. Detection of nucleic acid sequence differences using the ligase detection reaction with addressable arrays. Australian Patent 735,440, filed February 5, 1997 and issued October 18, 2001. More information below.
16. Francis Barany, Norman P. Gerry, Nancy E. Witowski, Joseph Day, Robert P. Hammer, and George Barany. Detection of nucleic acid sequence differences using the ligase detection reaction with addressable arrays. U.S. patent 6,506,594, filed March 16, 2000 and issued January 14, 2003. Licensed to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.
17. George Barany, Fernando Albericio, Knud J. Jensen, Micheal F. Songster, Jordi Alsina, and Josef Vágner. Support material for solid phase organic synthesis. U.S. patent 6,566,494 filed May 11, 1999 and issued May 20, 2003. Licensed to PerSeptive Biosystems, Framingham, MA, and later to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.

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Patents (continued)

18. Francis Barany, Matthew Lubin, George Barany, and Robert P. Hammer. Detection of nucleic acid sequence differences using coupled ligase detection and polymerase chain reactions. U.S. patent 6,797,470, filed July 30, 2001 and issued September 28, 2004. Licensed to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.
19. Francis Barany, George Barany, Robert P. Hammer, Maria Kempe, Herman Blok, and Monib Zirvi. Detection of nucleic acid sequence differences using the ligase detection reaction with addressable arrays. U.S. Provisional Application Serial No. 09/963,698, 09/963,920, and 09/986/527, filed February 9, 1996, and amended several times, most recently September 26, 2001 and November 9, 2001. See also *Chem. Abstr.* **127**, 214947 (1997) and *Chem. Abstr.* **137**, 305710 (2002), the latter entitled "Detection of alleles of genes by a combination of allele-specific ligase detection reaction and hybridization of ligation products to an addressable array." U.S. patent 6,852,487, filed February 4, 1997 and issued February 8, 2005. Licensed to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.
20. Francis Barany, Norman P. Gerry, Nancy E. Witowski, Joseph Day, Robert P. Hammer, and George Barany. Detection of nucleic acid sequence differences using the ligase detection reaction with addressable arrays. U.S. Provisional Application Serial No. 10/272,152, filed October 15, 2002. Licensed to Applied Biosystems/Perkin Elmer Inc., Foster City, CA.
21. Krzysztof Darlak and George Barany. Polymer-supported reagent for the preparation of disulfide-bridged peptides. U.S. Patent Application Serial No. 11/165,609, filed June 23, 2005. Assigned to Peptides International, Inc., Louisville, KY.

Note: Only U.S. patents are listed, but almost all of these inventions have corresponding international patent protection.

Professor George Barany has 36 issued U.S. patents which span the fields of peptide synthesis resin supports (PEG-PS, CLEAR), peptide synthesis reagents and protecting groups (PAL, HAL, XAL, BAL, Clear-OX), technologies for the synthesis of antisense (phosphorothioate) DNA and RNA, as well as universal DNA arrays for detection of genetic diseases.

Here is a link to Barany's inventions:

<http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=/nethtml/PTO/search-bool.html&r=0&f=S&l=50&TERM1=George&FIELD1=INNM&co1=AND&TERM2=Barany&FIELD2=INNM&d=PTXT>

To date [information received from the Office of Technology Commercialization], these inventions have netted nearly \$1.4 million in royalties and licensing fees to the University of Minnesota, divided roughly equally between the peptide reagents and materials, and the DNA array work. In addition, Barany's work in the latter area has generated over \$2 billion in revenue for over a dozen commercial entities, and the University of Minnesota (along with Cornell University and Louisiana State University) is currently involved in litigation to recover appropriate compensation for this intellectual property.

GEORGE BARANY

Research Collaborators at University of Minnesota

Postdoctoral Fellows

- Urszula Słomczyńska, October 1982 - September 1984 [*current*: Director of Medicinal Chemistry, Apath, LLC, St. Louis, Missouri; recipient Polish Academy of Sciences Award for Outstanding Scientific Achievements in Peptide Chemistry, 1989]
- Andrew W. Mott, November 1982 - August 1984 [*current*: Advisory Field Applications Scientist at Biovia, a division of Dassault Systèmes; 25 patents leading to two commercial products; Fellow of the Royal Society of Chemistry since 1996; recipient 3M Circle of Technical Excellence and Golden Step awards]
- Fernando Albericio, January 1983 - December 1984 (partially supported by fellowship from Generalitat of Catalunya, Spain) [*current*: President/Rector, Yachay Tech, Ecuador, following Professor of Organic Chemistry, University of Barcelona, Spain; Executive Director of Barcelona Science Park; and Group Leader, Barcelona Biomedical Research Institute; recipient Leonid Zervas Award, European Peptide Society, 1994; named to Research Chair, Generalitat of Catalunya, 2003-2008; recipient, Vincent du Vigneaud Award, American Peptide Society, 2011]
- Lajos Gera, April 1986 - May 1987 [*current*: Senior Instructor, Department of Biochemistry and Molecular Genetics, University of Colorado Health Sciences Center, Denver, CO]
- Peter Hegyes, September 1988 - April 1990 [*current*: Assistant Professor, Department of Organic Chemistry, University of Szeged, Hungary]
- Jane L. Chang, December 1988 - June 1990 [*current*: Chemistry Reviewer, Food and Drug Administration, Silver Spring, MD]
- Núria A. Solé, January 1990 - October 1993 (partially supported by fellowship from Ministry of Education and Science, Spain) [*most recently*: Scientist, Applied Biosystems, Inc., MA]
- Roger J. Bontems, June 1990 - September 1990 [*current*: Unknown]
- Zhenping Tian, August 1990 - August 1991 [*current*: Research Investigator, Abbott Laboratories, Chicago, IL]
- Josef Vágner, October 1992 - October 1995 [*current*: Associate Research Professor of Chemistry, University of Arizona, Tucson, AZ]
- Knud J. Jensen, January 1993 - January 1997 (partially supported by Alfred Benzon fellowship, Denmark) [*current*: Professor of Chemistry, University of Copenhagen, Denmark; recipient Holms's Research Prize, 2004, for excellence in organic chemistry, Denmark; Leonid Zervas Award, European Peptide Society, 2012]
- Jan Tejbrant, February 1993 - November 1994 [*current*: Senior Scientist, Medivir AB, Stockholm, Sweden; recipient in 2000 of "Medicinal Chemist of the Year," Pharmacia Corporation, Sweden]
- Eduard Bardají, October - December 1993; July - September 1997 (with support from Spanish agencies) [*current*: Co-founder, AMPbiotech, Spain; previously, Profesor Titular of Chemistry, University of Girona, Spain]
- Elisar Barbar (Woodward laboratory), January 1994 - December 1997 (partially supported by USPHS postdoctoral fellowship) [*current*: Professor of Biochemistry and Biophysics, Oregon State University; recipient National Science Foundation CAREER Award, 2002-2008]
- Divakaramenon Venugopal, June 1994 - November 1995 [*current*: Director, HighTech Analytical and Diagnostic Solutions, Gaithersburg, MD]
- Maria Kempe, July 1994 - July 1996 (partially supported by Hans Werthén fellowship, Sweden) [*current*: Section Head, Pharmacology and Structural Biology, and Universitetslektor/Docent, Nanomedicine and Biomaterials, Department of Experimental Medical Science, Biomedical Center, Lund University, Sweden; winner of "Individual grant for the advancement of research leaders - INGVAR" for period 2001-2007]

Research Collaborators at University of Minnesota (continued)

Postdoctoral Fellows (continued)

- Jack E. Richman, January 1995 - October 1996 (part-time) [*current*: Research Assistant Professor, Department of Biochemistry, Molecular Biology and Biophysics, University of Minnesota, Minneapolis, MN]
- Nancy E. Witowski, October 1995 - June 2002 [*current*: Research Associate, Department of Surgery, University of Minnesota, Minneapolis, MN]
- Yvonne M. Angell, September 1996 - September 1998 (USPHS postdoctoral fellowship) [*current*: Director of Peptide and Protein Chemistry, Ipsen Bioscience, Cambridge, MA]
- Chongxi Yu, November 1996 - May 1998 [*current*: founder and owner of Techfields Biochem Company, Ltd.]
- Marta Planas-Grabuleda, January 1997 - January 1999 and Summer 1999 (NATO fellowship and support from Spanish agencies) [*current*: Profesor Titular of Chemistry, University of Girona, Spain]
- Lin Chen, January 1997 - March 1999 [*current*: Senior Process Research Chemist, Roche Colorado Corporation, Boulder, CO]
- Jordi Alsina, November 1997 - July 2000 (partially supported by Spanish fellowship) [*current*: Senior Peptide Chemist, Eli Lilly and Company, Indianapolis, IN]
- T. Scott Yokum, March 1998 - August 2000 (primarily supported by USPHS postdoctoral fellowship) [*current*: Principal Scientist, TransTech Pharma Inc, High Point, NC]
- Rong Liu, May 1999 - May 2001 [*current*: Research Scientist, Pharmacopeia Drug Discovery, Inc.]
- Jaya T. Varkey, September 1999 - April 2003 [*current*: Lecturer, Department of Chemistry, St. Teresa's College, Ernakulam, Kochi, Kerala, India]
- Tracey L. Baas, April 2000 - December 2002 (partially supported by USPHS postdoctoral fellowship) [*current*: Senior Editor, SciBX (Nature Publishing Group)]
- Dominique Lelièvre, September 2000 - August 2001 [*current*: Research Engineer, Centre National de la Recherche Scientifique (CNRS), Centre de Biophysique Moléculaire (CBM)]
- Irina Getun, January 2001 - April 2004 [*current*: Research Associate, Genome Plasticity Laboratory, Scripps, FL]
- Daniel G. Mullen, April 2003 - March 2011 [*current*: retired from science]
- Rita Majerle, August 2003 - present (Associate Professor of Chemistry, Hamline University, St. Paul, Minnesota, via RSEC program)
- Mian Liu, October 2003 - February 2007 and February 2012 - February 2014 [*current*: statistical programmer, Sanofi-Aventis]
- Sharon Gazal, November 2003 - October 2005 [*current*: Unknown]

Research Collaborators at University of Minnesota (continued)

Graduate Students

- Alayne L. Schroll, October 1980 - August 1986, Ph.D. "Novel Organosulfur Chemistry and its Applications to Peptide Synthesis. I. Preparations of Symmetrical and Mixed Carbamoyl and Amino Polysulfanes. II. A New Protecting Group for the Sulfhydryl Function of Cysteine." [*current*: Professor of Chemistry and Leavy Family Endowed Chair of Chemistry, Chemistry and Physics Department, Saint Michael's College, Colchester, VT]
- Shmuel Zalipsky, October 1981 - August 1986, Ph.D. awarded April 1987, "Development of New Functionalized Polymers and Their Utilization in Peptide Chemistry." [*current*: following numerous positions in biotechnology specializing in PEGylation, now consultant in pharmaceuticals, drug delivery, and biotechnology for SJZ, his own company in the San Francisco Bay area, CA]
- Daniel G. Mullen, February 1982 - July 1987, Ph.D. "Design and Characterization of a Silicon-Functionalized Handle for Use in Solid-Phase Peptide Synthesis." Henkel Corporation Fellow in Chemistry, 1985-1986. [*most recent*: Senior Postdoctoral Fellow, University of Minnesota, Department of Chemistry, Minneapolis, MN (retired 2012), following Senior Research Scientist, Integra Lifesciences Corp., San Diego, CA]
- Lewis N. Bell, January 1983 - December 1985, written prelim. passed June 1983, left without writing up M.S. thesis entitled "An Acid Labile Handle for Solid-Phase Peptide Synthesis of C-Terminal Peptide Amides," deceased May 18, 1987
- Pamela M. Fier, March 1983 - June 1984, M.S. "Syntheses of Two Putative Peptides Encoded by Rous Sarcoma Virus RNA." [*current*: Science teacher, Marshall High School, Marshall, MN]
- Nancy G. Kneib-Cordonier, February 1984 - June 1989, Ph.D. "Synthesis and Characterization of a Tris(alkoxy)benzylamide Handle and its Application to the Solid-Phase Synthesis of Peptide Amides." [*current*: part-time teaching, Parkersburg, West Virginia]
- Robert P. Hammer, January 1986 - August 1990, Ph.D. "New Chemistry for Solid-Phase Peptide Synthesis: Anchoring, Disulfide Bond Formation, and Coupling Methods." University of Minnesota Graduate School Fellow, 1985-1987; Graduate School Dissertation Fellow, 1987-1988; Amoco Corporation Fellow, 1988-1989. [*current*: Group Leader, Ra Pharmaceuticals, Cambridge, MA; following Director of Chemistry, New England Peptide, and William A. Pryor Professor of Chemistry, Louisiana State University, Baton Rouge, LA; LSU Distinguished Faculty Award, 2003]
- Robert J. Van Abel, March 1988 - March 1993, was on leave August 1990 - March 1991 for Operation Desert Shield/Storm. Left to pursue interests in private industry. [*most recent*: Director of Information Technology, Marshalltown Company, Marshalltown, IA]
- Mark C. Munson, March 1989 - November, 1993, Ph.D. "Synthesis of Disulfide-Containing Peptides: New Strategies and Tactics." Amoco Corporation Fellow, 1992-1993 [*current*: Assistant Director, Medicinal Chemistry, Sanofi, Waltham, MA]
- Marc Ferrer, October 1989 - June 1994, Ph.D. "Chemical Synthesis and Structural Characterization of Native Sequence and Partially Folded Analogs of Bovine Pancreatic Trypsin Inhibitor (BPTI)." Fulbright Fellow, 1991-1994 [*current*: Team Leader, National Chemical Genomics Center, NCATS, NIH, Rockville, MD]
- Michael F. Songster, November 1989 - July 1996, Ph.D. "Design, Synthesis, and Implementation of Handles for Solid-Phase Peptide Synthesis." [*current*: Director of Information Technology, Biosearch Technologies, Inc., Novato, CA]

Research Collaborators at University of Minnesota (continued)

Graduate Students (continued)

- Elizabeth A. Ottinger, March 1990 - July 1994, Ph.D. "Development of Chemical Methods for Synthesis of Phosphorylated Peptides and Applications to Biological Problems." du Pont Fellow, 1992-1993; Stanwood Johnston Memorial Fellowship from Graduate School, 1993-1994. [*most recent*: Project Manager, NIH, Rockville, MD]
- Yongxin Han, February 1991 - October 1996, Ph.D. "Applications of Xanthenyl Chemistry to 9-Fluorenylmethyloxycarbonyl (Fmoc) Solid-Phase Peptide Synthesis." [*current*: General Manager, Centaurus BioPharma Co., Ltd, Beijing, China]
- Qinghong Xu, February 1992 - November 1996, Ph.D. "I. Synthesis of Phosphorylated Peptides and Applications for Studies of Protein-Protein Interactions. II. Development of Mild Methods for the Preparation of Modified Oligonucleotides." [*current*: Partner, Lung Tin International Intellectual Property Agent LTD., Beijing, China]
- Lin Chen, November 1991 - January 1997, Ph.D. "Organosulfur Chemistry and Some Applications to Peptide Synthesis." [*current*: Distinguished Scientist, Corden Pharma Colorado, Boulder, CO]
- Paul R. Hansen, January 1993 - May 1994, Ph.D. granted September 1996 by Chemistry Department, Royal Veterinary and Agricultural University (A. Holm, principal advisor in Denmark; Barany advisor for portion of work carried out at Minnesota), "New Strategies in the Synthesis of 2-Acetamido-2-deoxy- β -D-glucopyranose O-Glycopeptides, Neoglycoconjugates, and Photoactivatable Peptides." [*current*: Associate Professor, Department of Drug Design and Pharmacology, University of Copenhagen, Denmark]
- Christopher M. Gross, January 1994 - September 2000, Ph.D. "Synthetic Studies on Bovine Pancreatic Trypsin Inhibitor (BPTI). I. Optimized Stepwise Protocols. II. Segment Condensation Strategies." NIH Training Grant Fellow, 1995 - 1996. [*current*: Patent Examiner, U.S. Patents and Trademarks Office, Washington, DC]
- Hong Pan (Woodward laboratory), April 1994 - January 1997, Ph.D. "Nuclear Magnetic Resonance Studies of Denatured States of Bovine Pancreatic Trypsin Inhibitor." [*current*: Unknown]
- Ioana Annis (nee Stoenescu), January 1995 - July 1999, Ph.D., "Design and Preparation of Novel Solid-Phase Reagents for the Formation of Sulfur-Sulfur Bridges in Peptides and Proteins under Mild Conditions." National Science Foundation Predoctoral Fellow, 1994 - 1997; Graduate School Dissertation Fellow, 1998-1999. [*current*: Senior R&D Specialist, The Dow Chemical Company, Buffalo Grove, IL]
- Jordi Alsina, June 1995 - September 1995, Ph.D. granted October 1997 by Chemistry Department, University of Barcelona (F. Albericio, advisor; Barany advisor for portion of work carried out at Minnesota), "Diseño, Síntesis y Aplicaciones de Nuevos Espaciadores Bifuncionales en Síntesis de Péptidos en Fase Sólida." [*current*: listed with postdoctoral fellows]
- Balazs Hargittai, January 1996 - August 1999, Ph.D. awarded January, 2000, "I. Chemical Syntheses and Biological Activities of Disulfide-Paired Isomers and Lactam Analogues of Alpha-Conotoxin SI. II. A New Side-Chain Anchoring Strategy for Solid-Phase Synthesis of Peptide Acids with C-Terminal Cysteine." [*current*: Assistant Professor of Chemistry, Saint Francis University, Loretto, PA]
- Natàlia Carulla-Casanovas, November 1996 - September 2001. Ph.D., "Design, Synthesis, and Characterization of Beta-Sheet Peptides and Proteins." Louise T. Dossdall Fellowship from Graduate School, 1999-2000; Graduate School Dissertation Fellow, 2000-2001. [*current*: Institut de Recerca Biomèdica de Barcelona; recipient 2004 Reincorporation Fellowship from the Generalitat de Catalunya]

Research Collaborators at University of Minnesota (continued)

Graduate Students (continued)

- Joseph C. Kappel, November 1996 - October 2003, Ph.D. “Synthetic Strategies for Solid-Phase Synthesis: I. Design, Synthesis, and Applications of Handles. II. Combinatorial Synthesis of Small Molecules.” NIH Biotechnology Training Grant Fellow, 1998 - 2000. [*current*: completed postdoctoral with Prof. J. Martinez, Montpellier, France]
- Simon K. Shannon, January 1998 - November 2003, Ph.D. “Development of New Tools for Solid-Phase Organic Library Synthesis: Backbone Amide Linker (BAL) Anchoring Approaches and Monitoring Methods.” NIH Biotechnology Training Grant Fellow, 2003 [*current*: Senior Research Chemist, 3M Corporate Research Laboratory, St. Paul, MN; Founding President of University of Minnesota chapter of National Organization of Black Chemists and Chemical Engineers (NOBCChE); recipient TRIO Achievement Award, 2014]
- Judit Tulla Puche, August 2000 - February 2004, Ph.D. “I. Palladium-Mediated Strategies for the Synthesis of Small Molecules. II. Synthetic Studies Towards Partially Folded Peptides.” [*current*: Senior Scientist, Barcelona Science Park, Barcelona, Spain]
- Larry R. Masterson, May 2004 - December 2008, Ph.D. (G-l. Veglia, advisor; Barany co-advisor), “Towards the Full Molecular Details of Protein Kinase A Mediated Catalysis by NMR Spectroscopy.” NIH Chemistry Biology Interface Training Grant, July 2005 - June 2006 [*current*: Assistant Professor of Chemistry, Hamline University, St. Paul, Minnesota]
- Andrew J. Borgert, September 2003 – January 2009, Ph.D. (D. Live, advisor; Barany co-advisor), “Structural Consequences of Mucin Glycosylation.” [*current*: Biostatistician, Department of Medical Research, Gundersen Lutheran Medical Foundation, La Crosse, WI]

In addition, well over a hundred University of Minnesota undergraduate students [a number of whom held University Research Opportunity Program (UROB), Lando, McNair, or other fellowships] have conducted research in the Barany laboratory. I have also mentored a number of high school students, including two who were supported by the American Chemical Society’s Project SEED [Summer Research Internship Program for Economically Disadvantaged High School Students].